

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
24 October 2002 (24.10.2002)

PCT

(10) International Publication Number
WO 2002/083306 A3

- (51) International Patent Classification⁷: **B01J 31/14**, 31/12, 31/22, C07C 2/30, 11/107
- (21) International Application Number: **PCT/ZA2002/000064**
- (22) International Filing Date: 12 April 2002 (12.04.2002)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
- | | | |
|------------|----------------------------|----|
| 60/283,417 | 12 April 2001 (12.04.2001) | US |
| 60/283,419 | 12 April 2001 (12.04.2001) | US |
| 2001/3047 | 12 April 2001 (12.04.2001) | ZA |
| 2001/3049 | 12 April 2001 (12.04.2001) | ZA |
- (71) Applicant (for all designated States except US): **SASOL TECHNOLOGY (PTY) LTD [ZA/ZA]**; 1 Sturdee Avenue, Rosebank, 2196 Johannesburg (ZA).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **GROVE, Jacobus, Johannes, Cronje [ZA/ZA]**; 9 Marieskop Road, Glenvista, 2091 Johannesburg (ZA). **MORGAN, David, Hedley [ZA/ZA]**; 64 Berg-en-dal, Greymont, 2000 Johannesburg (ZA). **SCHWIKKARD, Sianne, Lindsay [ZA/ZA]**; 14 Sasurei, Toon van den Heever Street, 1947 Sasolburg (ZA). **BEZUIDENHOUDT, Barend, Christiaan, Buurman [ZA/ZA]**; 35 Rubens Street, 1947 Sasolburg (ZA).
- (74) Agents: **DUNLOP, Alan, J., S. et al.**; Hahn & Hahn Inc., 222 Richard Street, Hatfield, 0083 Pretoria (ZA).
- (81) Designated States (*national*): AE, AG, AL, AM, AT (utility model), AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ (utility model), CZ, DE (utility model), DE, DK (utility model), DK, DM, DZ, EC, EE (utility model), EE, ES, FI (utility model), FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Published:
- with international search report
 - with amended claims
- (88) Date of publication of the international search report: 24 April 2003
- Date of publication of the amended claims: 27 May 2004
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: OLIGOMERISATION PROCESS AND CATALYST SYSTEM

(57) Abstract: The invention provides a catalyst system for the oligomerisation of olefins, which catalyst system is prepared from catalyst components selected from the group including at least a chromium source, a substituted phenol, and an organoaluminium compound. The invention further provides an aromatic ether component for a trimerisation catalyst system and an oligomerisation process using said catalyst.

AMENDED CLAIMS

[received by the International Bureau on 12 February 2003 (12.02.03);
original claims 1-8 and 18-26 replaced by amended claims 1-8 and 18-26 (2 pages)]

1. A catalyst system for the oligomerisation of olefins, which catalyst system is prepared from catalyst components, which components include at least a chromium source, a substituted phenol, and an organoaluminium compound.
2. A catalyst system as claimed in claim 1, which catalyst system is suitable as an ethylene trimerisation catalyst system.
3. A catalyst system as claimed in any one of the preceding claims, wherein the substituted phenol is a di-substituted phenol.
4. A catalyst system as claimed in any one of the preceding claims, wherein the substituted phenol is a di-aryl-substituted phenol.
5. A catalyst system as claimed in any one of the preceding claims, wherein the substituents on the phenol are linear or branched hydrocarbon groups containing 1 to 30 carbon atoms.
6. A catalyst system as claimed in any one of the preceding claims, wherein the organoaluminium compound is an alkyl aluminium compound.
7. A catalyst system as claimed in any one of the preceding claims, wherein the organoaluminium compound is in the form $\text{Al}(\text{R})_3$ in which R is a linear or branched hydrocarbyl group having from 1 to 6 carbon atoms.
8. A catalyst system as claimed in any one of the preceding claims, wherein the substituted phenol is 2,6-diphenylphenol.

18. A process for the trimerisation of ethylene to 1-hexene, said process including the contacting of an ethylene containing stream under oligomerisation reaction conditions with a catalyst system which is prepared from catalyst components, which components include at least a chromium source, a substituted phenol, and an organoaluminium compound, said process being
5 carried out in a desired temperature range of 100°C to 140 °C.
19. A process as claimed in claim 18, wherein the catalyst components from which the catalyst system is prepared include an aromatic ether.
- 10 20. A process as claimed in claim 19, wherein the process is carried out at a temperature of 117°C to 125°C.
21. A process as claimed in claim 20, wherein the process is carried out at a
15 temperature of 120°C.
22. A process as claimed in any one of claims 18 to 20, which is carried out at a pressure of above 10 Barg.
- 20 23. A process as claimed in any one of claims 18 to 22, which is carried out at a pressure of above 20 Barg.
24. A process as claimed in claim 23, which is carried out at a pressure of above 30 Barg.
- 25 25. A process as claimed in any one of claims 18 to 24, in which the catalyst system is present at an elemental chromium concentration, of less than 0.1 mmol/100ml.
- 30 26. A process as claimed in any one of claims 18 to 25, wherein the process is performed by the introduction of an ethylene feedstock into a reactor with the

THIS PAGE BLANK (USPTO